Mission of the Session

"Detector Design"

Appec Recommendations Neutrino Telescopes

- → With the aim of constructing a detector of km3 scale in the Northern hemisphere, both in view of size and competition with IceCube: form a single coherent collaboration collecting *all* the efforts underway
- \rightarrow Prepare report to ApPEC PRC with following informations:
 - optical properties of water, incl. seasonal variations and using the same devices
 - optical background and sedimentation
 - comparative simulations about impact of depth and water properties to some benchmark km3 detectors (focussing to the central goals of Nu Telescopes)
- \rightarrow Single design study in the European FP6 framework
- \rightarrow New review in one year (summer 2004)

Aims

- Find a class of "best" detector designs.
- Find out, whether there is a "best site" or a "worst" site.
- Best and worst refer only to physics, not to technology, although a simulated detector should be technologically realistic.
- Site selection: If performance differences are smaller than 30% (50% ?) other criteria will dominate the selection.

Aims (cont'd)

- What input values are sill missing ? What still has to be measured ?
- What are the appropriate physics benchmark parameters ?
- Site comparison: with which benchmark detectors should the comparison be made ?
- Which tools and methods will be used for simulation, reconstruction and background rejection ?

Some the	oughts	about	site
4	NTARES	NEMO	NESTOR
Depth (km):	2.4	3.4	4-5
Factor downward muon intens	sity \leftarrow ~5 -	\rightarrow \leftarrow ~ :	$3 \rightarrow$
Absorption length (m):	45-65	65	60-70
Attenuation length (m)	35	35	30-50
External steady noise:	Same		
(KHZ/8 INCH tube)	60	30 ?	25-35 ?
Sedimentation:	strong	smaller	smaller
Water currents(cm/s):	2-4	3 (max 12	2) 2-4
Distance to shore (km)	: 20 (10)	70 (70)	20 (15)
10/7/2003 C.S	Spiering, VLVNT Wor	Shore st	مر ation (closest shore) ع

	ANTARES	NEMO	NESTOR
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all-µ Vertical Intensity for AMANDA-II



1. Background from misreconstructed downward muons

Downward muon ratio Antares : Nemo : Nestor ~ 15 : 3 : 1

Does that mean that Antares has 15 times more BG than Nestor ? (and is sqrt(15) ~ 4 times less sensitive ?)

$\rightarrow NO$

.. if downward muon background can be kept lower than the unavoidable background from atmospheric neutrinos !

(an ideal detector would reconstruct all downward muons as downward muons and reject them)

Amanda and Baikal have shown that this factor is much smaller than 4.

How large is it w.r.t. Antares : Nemo : Nestor ?

2. Visibility of sky

Even if the case of exact reconstruction, downward muons govern the rate if you move higher and higher above horizon. The onset is the later, the deeper the detector.

- → See a larger part of the sky for point soure search (not for contained muons and cascades)
- → Get more statistics for an excess in the diffuse flux of ν_{μ} (cuts for cascades weaker)

cascade signature

Cascades important since $v_e : v_\mu : v_\tau \sim 1:1:1$ (and not 1:2:0 for the isolated cascades only for NC

For high muon energies, the atm. downward muon BG decreases

→ Requires thourough MC study

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Shore station (closest shore)					

Water: Transmission Parameters

- Why is attenuation for Antares/Nemo the same (35 m) and absorption different (45/65) ?
- Stronger scattering at Nemo site ?
- Larger particles at Antares site ?
- Older Antares measurement gives abs. length of 60±8 m
- Need repeated measurements
- Include also Nestor site in measurements which are performend with one and the same device ! (like now for Antares, Nemo and Baikal)



Summary of variation of Bioluminescence, Antares



Stronger background → stronger cuts !

How does that influence the effective area (threshold, sensitivity)?

Similar long term measurements are requested from the other sites. Antares should a.s.a.p. continue these measurements with another Prototype line.

Water: Bioluminescence

- How varies noise in summer ?
- How varies the noise at the Nemo site ?
- Is the noise ratio Antares/Nemo 2:1 typical ? Can one expect seasonal surprises similar to Antares also at the other sites (although absolutely weaker) ?

Biologists say that bioluminescence in East Mediterranean is typically smaller than in the West part. Also, it is known that the bioactivity decreases dramatically between 2 and 3 km.

- Need repeated, long-term studies at all three sites
- Need these measurements asap as input for MC studies (How strong does one has to cut to suppress noise ?) 10/7/2003 C.Spiering, VLVNT Workshop



NEMO and NESTOR have lower biofouling. How does that change with season and year ?

Can one judge from measurements with sediment traps ?

Measurements of Nemo and Nestor have been performed over smaller time periods than the Antares experience from nearly one year (see following slide).

Are we absolutely sure that the deeper detectors can look upward for > 3 years ?

Diffuse flux of UHE muon neutrinos (> 1 PeV): Upward looking modules are useful ! Also for measuring shadow of moon or any other calib. with downward muons.





